Bioremediation of wastewater: a microalgae-based approach

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Background

Circular economy: promotion of more rational and sustainable use of resources and waste management.

Green pRocesses for Industrial Productions and cost-effective effluents valorization (GRIP) project:

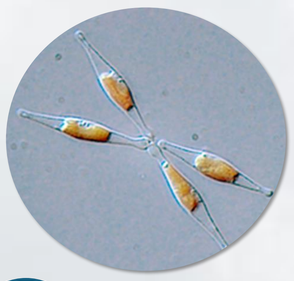
- Implementation and application of the circular economy
- Promotion of rational and sustainable use of resources and waste management

Application of circular economy approaches to freshwater resource management:

- Sustainable and circular approach to **water resource management**
- **Valorization and reuse** of liquid wastes
- **Preservation** of the natural capital

Bioremediation using microalgae is a sustainable and high-potential strategy for wastewater valorization and reuse.

Diatoms are a promising algal group, but they are still little used for wastewater treatment applications.



Specific Aim

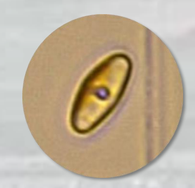
1. Test diatoms growth response to increasing nutrient concentrations
2. Evaluate the bioremediation potential

Methods

Diatoms

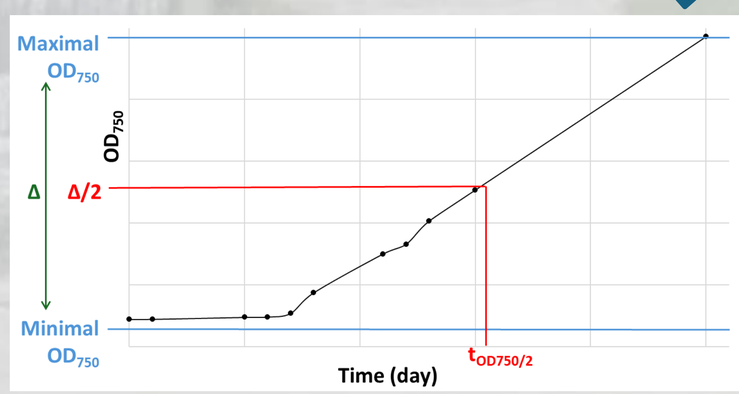
One pelagic species and two benthic species:

- *Phaeodactylum tricornutum:* Pt1 strain grown in regular F/2 (*salt Pt*) and F/2 without NaCl (*fresh Pt*)
- *Achnanthidium* sp.
- *Planothidium frequentissimum*



Tests performed in multiwell plates:

- Absorbance at **Optical Density 750**
- $t_{OD750/2}$ inferred from OD data



Spiked Aquaculture Wastewater

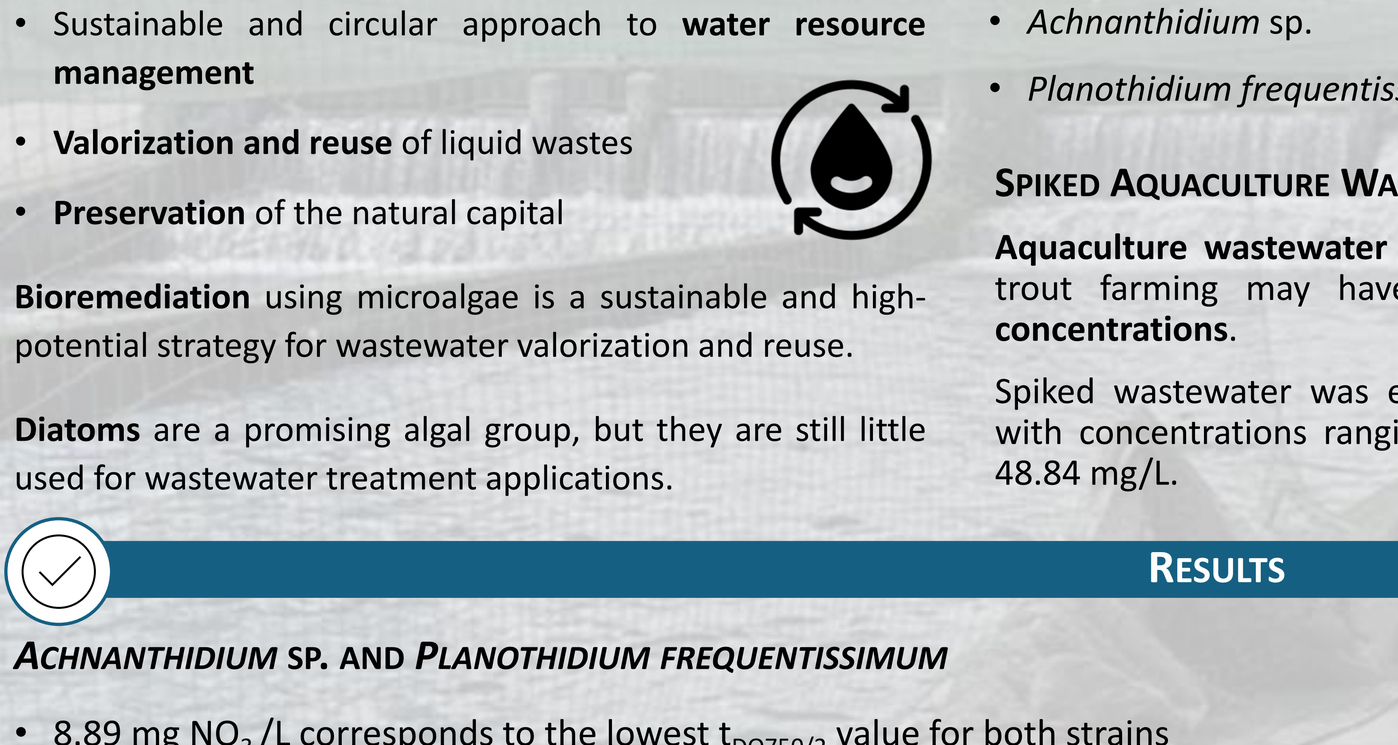
Aquaculture wastewater originating from trout farming may have high **nutrient concentrations**.

Spiked wastewater was enriched in **NO_3**, with concentrations ranging from 0.15 to 48.84 mg/L.

Results

Achnanthidium sp. and *Planothidium frequentissimum*

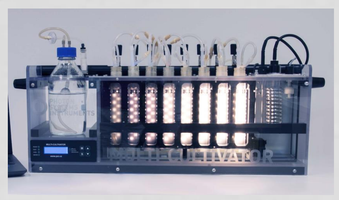
- 8.89 mg NO_3 /L corresponds to the lowest $t_{DO750/2}$ value for both strains
- 8.89 mg NO_3 /L is the best concentration for unialgal culture
- Diatom Medium (DM), consisting of 0 mg NO_3 /L, determines high $t_{DO750/2}$



- NO_3 concentrations from this study are consistent with tolerance ranges and optima values for species in natural biofilms (data from North Italy)
- *Achnanthidium* and *Planothidium* species demonstrate the ability to grow in **waters with moderate-to-bad ecological status** in both unialgal condition (this study) and diatom communities (data from North Italy)
- The two species are suitable candidates for bioremediation trials

Phaeodactylum tricornutum

- *Salt Pt and fresh Pt* demonstrate growth in a wide NO_3 concentration: 0.15 – 664.71 mg/L
- *Salt Pt* has a lower $t_{DO750/2}$ than *fresh Pt*
- F/2 Medium consisting of 664.71 mg NO_3 /L determines the lowest $t_{DO750/2}$
- Results are consistent with Scarsini et al., 2022: cell division rate is similar in a range 0.15 – 13 NO_3 mM



Future Perspectives

- Bioremediation tests in Multi Cultivator 1000-OD (PSI, Czech Republic)
- New strain: *Nitzschia palea*
- New effluents: dairy effluent, heavy metal-polluted wastewater

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